Would Fast Sailing Towards the Euro Be Smooth?: What Fundamental Real Exchange Rates Tell Us About Acceding Economies *

Katerina Smidkova and Ales Bulir**

Abstract

Computed fundamental real exchange rates in four acceding countries point out to difficulties in entering the ERM II too soon after the EU entry. Computations suggest that it is unlikely for the Czech, Hungarian and Polish economies to maintain low inflation during 2004-2010, and at the same time, to keep their currencies within the ERM II. In addition, those currencies were overvalued in 2003. Moreover, experience of Greece, Portugal, and Spain – viewed through the fundamental real exchange rates goggles - indicate both more stable paths of real exchange rates as well as smaller currency misalignments prior to the euro adoption than what can be expected from the acceding countries in the forthcoming years. If acceding countries sail too fast towards the euro, their sailing may not be as smooth as the one of frontrunners.

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** Katerina Smidkova, Adviser to the Board. Czech National Bank. Email: smidkova@cnb.cz. Aleš Bulíř, Senior Economist, International Monetary Fund, Email: abulir@imf.org.The views expressed in the paper are those of the authors, and do not represent those of the Czech National Bank and International Monetary Fund.

Non-technical Summary

All countries joining the European Union (EU) in May 2004 will be put to several tests before they are allowed to join the European Monetary Union (EMU). What are their prospects of adopting the euro fast and smoothly after the EU entry? Should they race to the euro area or should they be cautious and watch for potential conflict between a trend appreciation of real exchange rates and between the EMU tests requiring low inflation and stable exchange rates? Is there an additional risk in irrevocably fixing the exchange-rate parities vis-à-vis the euro soon after the EU entry due to the currency misalignment? These are questions that we address by computing fundamental real exchange rates (FRERs) for four acceding countries- the Czech Republic, Hungary, Poland, and Slovenia – and their "frontrunners" who joined the EU in the 1980s - Greece, Portugal and Spain.

Our analysis is motivated by the following stylised facts. First, prior to the euro adoption, acceding countries will probably need to worry about real appreciation much more than frontrunners did. If acceding countries introduce the ERM II soon after the EU entry, the average real appreciation in 1998-2003 should be comparable to the real appreciation of frontrunners in 1992-1997 which was on average 0.2 percent. However, acceding countries faced 2.7 percent real appreciation on average in a comparable time span. Second, we see foreign direct investment (FDI) as the main culprit in explaining this significant real exchange rate appreciation that is otherwise at odds with alternative explanations such as the sector and external-wealth accumulation effects. Due to massive inflows, the four acceding countries accumulated on average 25 percent of GDP of FDI prior to the EU entry. FDI played an important role also in the economic convergence of frontrunners although in their case the stock of FDI amounted on average only to 10 percent of GDP in 1997. Third, FDI inflows slowed down following the adoption of euro. At the same time, current account deficits of frontrunners deepened and their net external liabilities increased, on average to 40 percent of GDP. This accelerated accumulation was possible in part because the stock of debt was relatively low prior to the euro adoption. However, the existing external debt is comparatively higher in the four acceding countries, on average 30 percent of GDP, and any future increases may not be so easily sustained. Should a similar slowdown of FDI inflows materialise, it is unclear whether the acceding countries will be able to accumulate foreign liabilities in a fashion comparable to the frontrunners.

We apply the FRER model in order to estimate currency misalignments in four acceding countries prior to the EU entry and to produce forward-looking indicators of sustainability of nominal convergence in the medium run. We produce *ex post* comparable indicators for the frontrunners. The FRER model has two specific features distinguishing it from other models of sustainable, desirable or equilibrium real exchange rates. First, it is the only one emphasising the role of FDI in determining speed of real appreciation that can be explained by economic fundamentals. Second, the FRER model defines external balance in terms of stocks rather than flows. By employing a less binding definition of external balance, current account deficits can be relatively high and still be in line with economic fundamentals during a period of economic convergence. This corresponds to our intuition that the catch-up process is likely to be at its fastest in the pre-EMU period, and that as a result, current account deficits may exceed a conventionally assumed limit of 2-4 percent of GDP. However, temporarily larger deficits are only compatible with FRERs for those converging economies that have not inherited the excessive stock of external debt. We conduct extensive sensitivity tests and compare our findings with results of other papers to obtain additional robustness check.

We find that currencies of all analysed acceding countries but the Slovenian tolar were overvalued in 2003. This finding corresponds to results of other studies that have recently estimated currency misalignments in acceding countries and that used comparable, medium-term, methodologies. Forward-looking computations of the FRERs indicate that the currencies of acceding countries are unlikely to pass the EMU tests if real exchange rates converge to their equilibrium levels. Pursuing the convergence criteria too soon after the EU entry may prevent the Czech, Hungarian, and Polish economies from maintaining external balance. In contrast, the Slovenian currency may require revaluation prior to the euro adoption. *Ex post* simulations for frontrunners show no currency

misalignment at the time of introducing the ERM II. Moreover, after introducing the ERM II, their real exchange rates followed a more stable, medium-term path than what can be expected in the acceding countries.

Although our sample consists of only four acceding countries, we have been able to detect different problems regarding the compatibility between nominal convergence criteria and underlying economic fundamentals in the pre-EMU period. On one hand, for some acceding countries, currency misalignment can pose a serious problem. On the other hand, other acceding economies may succeed passing the EMU tests with a gradual revaluation strategy. Analogously, forward-looking analysis sends a warning signal only in some cases where it may not be viable to maintain external balance and at the same time meet nominal convergence criteria, no matter how softly the exchange-rate bands of the ERM II are interpreted. On the contrary, for some acceding countries, the actual interpretation of the exchange-rate stability may play an important role since FRERs may be only compatible with the broad exchange-rate bands.

The post-adoption experience of the frontrunners has interesting repercussions for the acceding economies. Should a slowdown of FDI inflows materialise — as observed in the case of frontrunners — convergence might decelerate in acceding countries. It would remain to be seen whether domestic investment would be sufficient to pick up the slack. Moreover, it is unclear whether the acceding countries will be able to accumulate foreign liabilities at a sufficient speed, given their already relatively high levels of external indebtedness. Their position in this respect is different from the one of frontrunners who could afford a further external debt accumulation.

For the above-mentioned reasons, an early “race to the euro” appears to be a costly competition, indeed. The frontrunners’ experience of smooth sailing into the euro area cannot be taken as an assurance of a similar performance for the acceding countries.

1 Introduction

European Union (EU) countries are put to several tests before they are allowed to join the European Monetary Union (EMU) and these tests will have to be passed by the countries joining the EU in May 2004. When their prospects of passing the EMU tests fast and smoothly are being evaluated, a possible conflict between a trend appreciation of real exchange rates, observed so far in acceding economies, and the EMU criteria of low inflation and stable exchange rate is often discussed. In addition, there is another issue at stake. If a currency were to be irrevocably fixed at an improper parity to the euro, the misalignment would have to be adjusted through other, more costly processes, such as domestic price or wage adjustment. Locking currencies into an exchange rate regime with the euro too early could remove the shock-absorbing role of monetary and exchange rate policies before the process of real convergence moves sufficiently forward.

The question we address in this paper can be simplified as follows: is the volatile process of real exchange rate appreciation in the former transition countries over, making the fast EMU entry trivial, or is it likely to continue for a few more years, resulting in potentially costly adjustment? In addition, we also examine if there were indications of currency misalignment in acceding countries prior to the EU entry.

Stylised facts regarding four acceding countries - the Czech Republic, Hungary, Poland, and Slovenia – and three "frontrunners" that joined the EU in the 1980s - Greece, Portugal and Spain - suggest that prior to the euro adoption acceding countries need to worry about real appreciation much more than frontrunners did. This being said under assumption that acceding countries adhere to their pre-announced schedules, join the euro area around 2007-2010, and hence, that the current experience of acceding countries is comparable to the one of frontrunners from the early 1990'. Between 1998 and 2003, the average real appreciation was 2.7 percent in our group of acceding countries while frontrunners faced only 0.2 percent real appreciation on average in a comparable period of 1992-1997.

We see foreign direct investment (FDI) as the main culprit in explaining real exchange rate appreciation in the four acceding countries that is otherwise at odds with alternative explanations such as the Balassa-Samuelson and external-wealth accumulation effects. Due to massive inflows of FDI, the four acceding countries accumulated on average 25 percent of GDP of FDI prior to the EU entry. FDI played an important role also in the economic convergence process of the frontrunners although in their case the stock of FDI amounted on average only to 10 percent of GDP in 1997.

We noticed also some surprising post-adoption developments of the frontrunners that could have interesting repercussions for acceding countries. FDI inflows slowed down following the adoption of euro. At the same time, current account deficits of frontrunners deepened and their net external liabilities increased. Should a similar slowdown of FDI inflows materialise, it is unclear whether the acceding countries will be able to accumulate foreign liabilities in a fashion comparable to the frontrunners, given their already high levels of external debt.

We apply the concept of fundamental real exchange rate (FRER) in order to analyse real exchange rates of acceding countries and those of frontrunners. The FRER model has been developed to measure how far real exchange rates of economies, converging to the EU economic level of development, are from values corresponding to the economic fundamentals and to estimate the sustainable path for the real exchange rates in the medium run.

The FRER model has two specific features distinguishing it from other models of sustainable, desirable or equilibrium real exchange rates. First, it is the only one emphasising the role of FDI in determining what speed of real appreciation can be explained by economic fundamentals. Second, the FRER model defines external balance in terms of stocks rather than flows. The definition of external balance is country specific. By employing a less binding definition of external balance, current account deficits can be relatively high and still be in line with fundamental real exchange rates (FRERs) during a period of

economic convergence. This corresponds to our intuition that the catch-up process is likely to be at its fastest in the pre-EMU period, and that as a result, current account deficits may exceed a conventionally assumed limit of 2-4 percent of GDP. However, temporarily larger deficits are only compatible with FRERs for those converging economies that have not inherited the excessive stock of external debt.

After the FRERs are computed under the baseline assumptions, extensive sensitivity tests and comparisons with other papers assessing real exchange rates of acceding countries are performed. Regarding the former, confidence bands are calculated both for in-sample and off-sample (projection) periods. While in-sample confidence bands are simulated using the estimation errors of trade equations, off-sample confidence bands are based in addition on historical standard errors of exogenous variables and uncertainty about the target value of external debt. Resulting confidence bands are of a similar order as compared to other studies on equilibrium real exchange rates. Regarding the latter, results are compared vis-à-vis recent studies. The FRER estimates of misalignment are of similar sign and magnitude when compared to other studies relying on analogous methodologies. The similar robustness check could not be made for off-sample projections since this issue has not been explicitly addressed in previous research on acceding countries.

Computations of FRERs in the four acceding countries point out to difficulties in entering the ERM II mechanism too soon after the EU entry. Of the four countries, all currencies but the Slovenian one were overvalued in 2003. An early fixing vis-à-vis the euro could increase likelihood of external imbalance and unsustainable exchange rate developments in all countries but Slovenia. Looking ahead, meeting convergence tests of exchange rate stability can be costly, owing to only gradual convergence of the equilibrium real exchange rates toward the narrow band. Computed FRERs suggest that it is unlikely for the Czech, Hungarian and Polish economies to maintain low inflation during 2004-2010, and at the same time, to keep their currencies within the ERM II.

Moreover, experience of frontrunners indicates both smaller currency misalignments as well as more stable paths of real exchange rates prior to the euro adoption than what can be expected from the acceding countries in the forthcoming years. Hence, benefits of the well-publicised “race to the euro” appear to be doubtful from this perspective. If acceding countries sail too fast towards the euro, their sailing may not be as smooth as the one of frontrunners.

The paper is organised as follows. Section 2 presents some stylised facts of acceding countries and the frontrunners. Section 3 summarises methodological background and outlines the second generation of the FRER model. Section 4 explains the baseline computations and sensitivity test. Section 5 shows empirical results for both acceding countries and the frontrunners. The final section concludes.

2 Stylised Facts

Our analysis is motivated by a few stylised facts regarding four acceding countries - the Czech Republic, Hungary, Poland, and Slovenia – joining the EU in May 2004 and three countries that joined the EU in the 1980s - Greece, Portugal and Spain - and which we will call the "frontrunners" [1]. Prior to the euro adoption, the frontrunners had had experience similar to that of acceding countries where the process of economic transformation took place in 1990s. Among common features, political and economic reforms and real economic convergence processes are worth mentioning. However, the two groups did not plan to adopt euro with the same speed. Frontrunners had had twice as much time to prepare for the euro adoption than acceding countries scheduled for themselves.

Prior to their EU entry, the Czech Republic, Hungary, Poland, and Slovenia announced in their Euro-strategies or in the Pre-accession Economic Programmes (PEPs) that they would like to join the euro area around 2007-2010, that is three to six years after joining the EU. Greece joined the EU in 1981, Portugal and Spain in 1986. Portugal and Spain introduced ERM II in the beginning of 1990s and Greece in 1998. Portugal and Spain introduced euro thirteen years after joining the EU, in 1999. Greece followed the suite in 2001, twenty years after joining the EU. In order to sail as smoothly into the euro area as the frontrunners did, acceding countries should be as prepared for the euro adoption in 2004 as the frontrunners were in the second half of 1990s. However, the selected stylised facts suggest that their sailing towards the euro may not be as smooth.

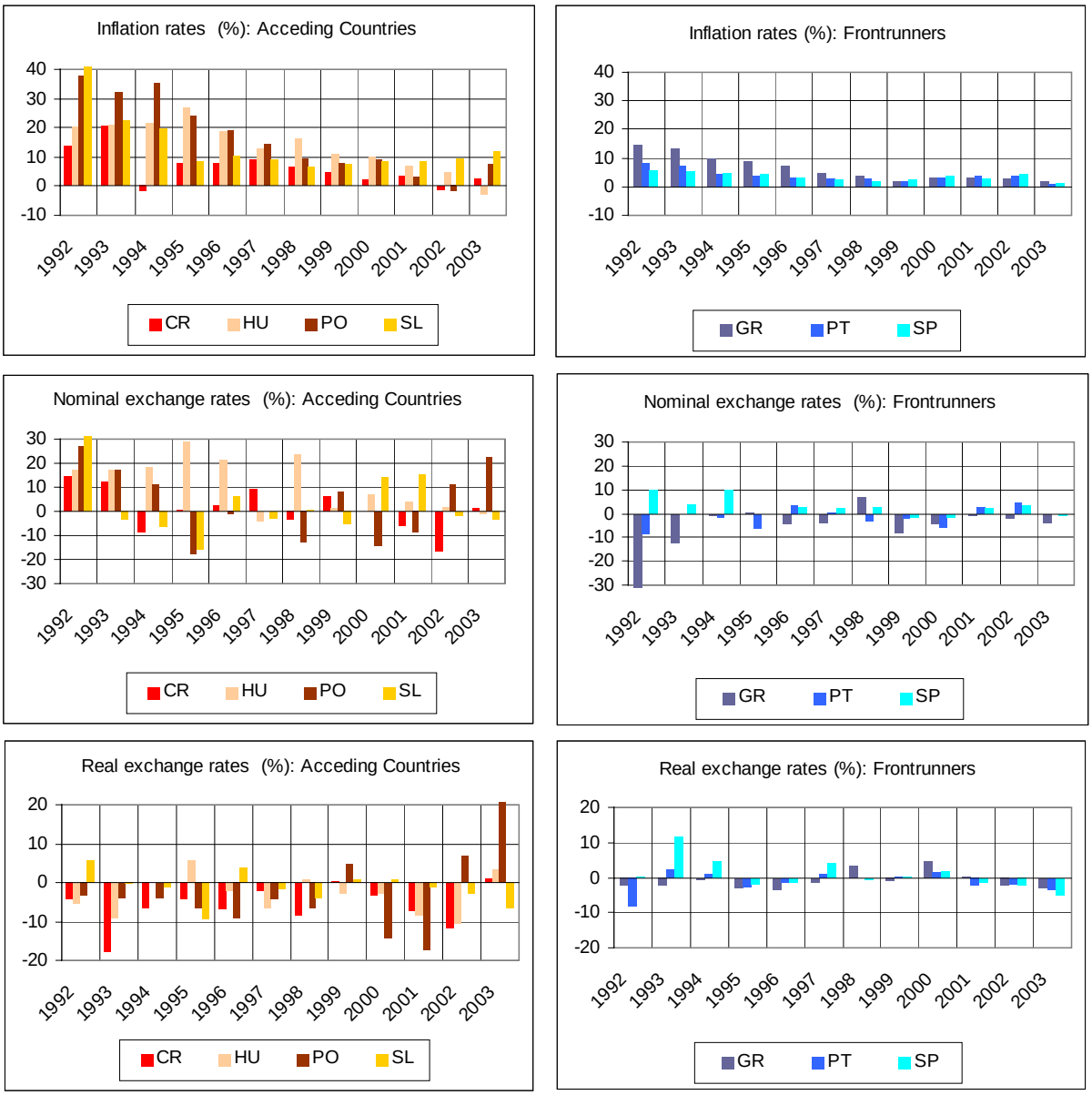
The currencies of acceding countries have appreciated substantially in real terms during the last decade (Figure 2.1). On average, between 1992 and 2003, real exchange rates in acceding countries appreciated by 3.3 percent. Between 1998 and 2003, the average real appreciation was 2.7 percent. Prior to adopting euro, the frontrunners appeared to fit similar pattern but at a much smaller scale. Frontrunners had to put up with real appreciation of 0.4 percent on average between 1992 and 2003. In a period 1992-97, the average real appreciation was 0.2 percent. Under assumption that the pre-announced schedules of the euro adoption are adhered to, acceding countries should worry about real appreciation ten times more than the frontrunners did in a comparable time span.

In the case of four acceding countries, the bulk of real appreciation has been effected through inflation differential as one might expect if the Balassa-Samuelson effect were significant. However, in the case of acceding countries, price de-regulations contributed to the changes in relative prices as well. In addition, a part of the early real appreciation resulted from an excessive devaluation at the start of the transition process[2]. On average, inflation rates were 14.4 percent between 1992 and 2003 and lower – around 6 percent - in a period of 1998-2003. The nominal effective exchange rates have shown a modest tendency to depreciate. On average, nominal depreciation rate was 6 percent between 1992 and 2003 and 1.7 in a period of 1998-2003. On the other hand, inflation rates of frontrunners reached lower levels at 4.5 percent between 1992 and 2003 and 2.8 percent in a period 1998-2003. Their nominal effective exchange rates have shown a tendency to appreciate. On average, nominal appreciation was 6.6 percent between 1992 and 2003 and 12.6 percent in a period 1992-1997.

[1] We focus on those four acceding countries—the Czech Republic, Hungary, Poland, and Slovenia — for which consistent data and country models are available from the National Institute Global Econometric Model (NiGEM). NiGEM contains country models of the analysed acceding economies as well as models of all their trading partners. Hence, computations of FRERs have a consistent macroeconomic framework. See Barrell et al (2002).

[2] See Halpern and Wyplosz (1997). Smidkova et al (2002) also suggests that in the first half of the 1990s real effective exchange rates were undervalued relative to their equilibrium level in the four acceding economies.

Figure 2.1 1992-2002: Inflation, Real and Nominal Effective Exchange Rates



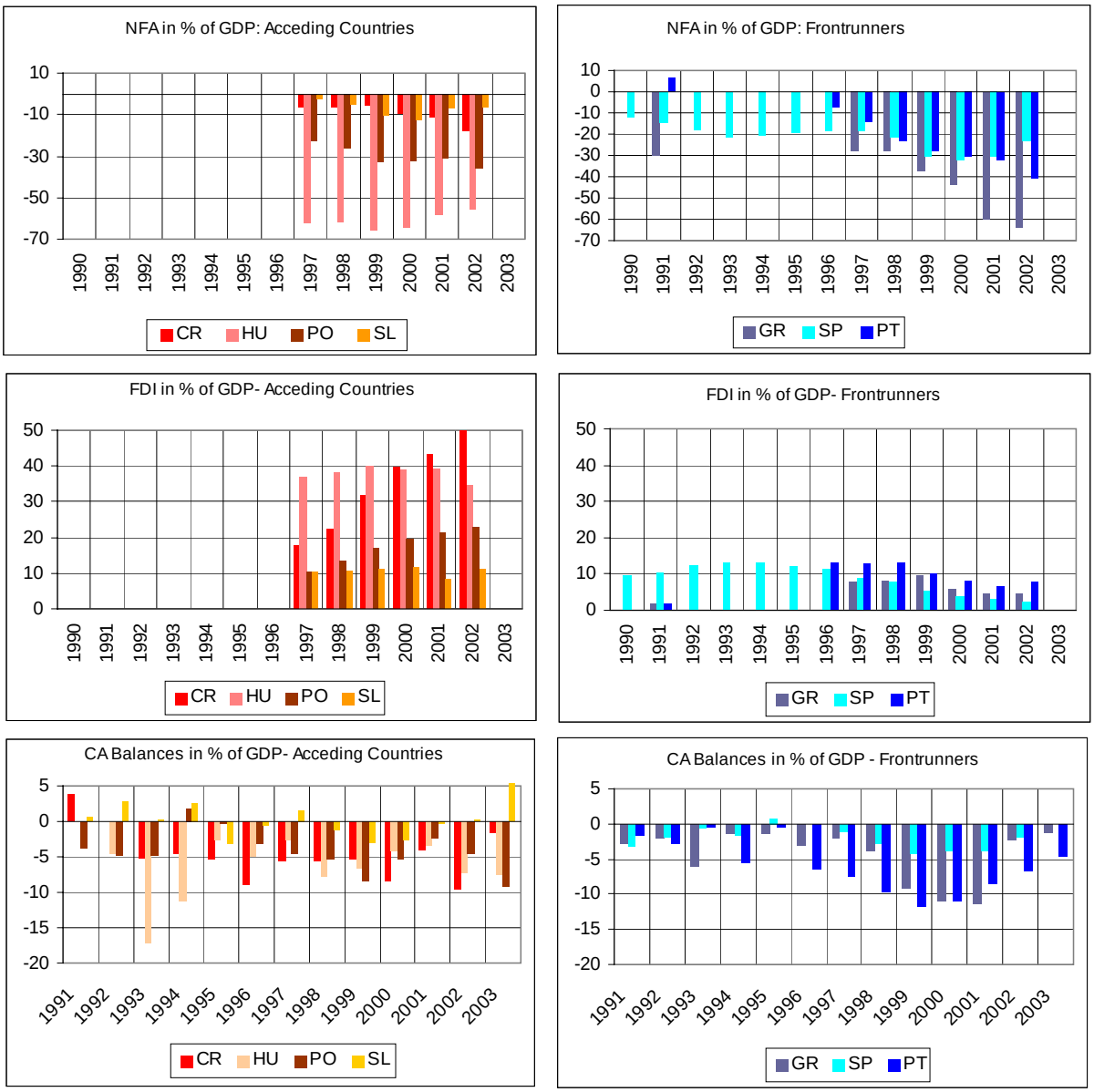
Note: All indicators are shown in percentage changes. Positive values of percentage changes in real and nominal effective exchange rates correspond to currency depreciation, real and nominal respectively.
Data sources: National institute Global Econometric Model (NiGEM), National central banks.
Abbreviations: Czech Republic (CR), Hungary (HU), Poland (PO), Slovenia (SL), Greece (GR), Portugal (PT), Spain (SP).

We see FDI as the main culprit in explaining real exchange rate appreciation in the four acceding countries that is otherwise at odds with alternative explanations such as the Balassa-Samuelson and external-wealth accumulation effects. The previous empirical work related to FDI in the former transition countries (Lansbury, Pain and Šmídková, 1996) supports this view. Prior to the EU enlargement, the four acceding countries accumulated on average FDI at an admirable level of 25 percent of GDP (Figure 2.2). Massive FDI inflows may have affected investors' perceptions about these countries' long-term sustainable external balances. For example, if exports are driven primarily by FDI—as compared to competitiveness of their exchange rates—contemporaneous capital inflows may signal expected future net exports consistent with appreciated real exchange rates (Benáček *et al*., 2003). FDI played important role also in the economic convergence process of the frontrunners although their stock of FDI amounted on average only to 10 percent of GDP in 1997.

Most empirical papers agree that rising total factor productivity in the tradable-good sector (the Balassa-Samuelson effect) has been of second order importance in explaining the gradual and long-lasting real

exchange rate appreciation in the former transition countries (De Broeck and Sløk, 2001, Égert, 2002b, Mihaljek, 2002, and Flek *et al.*, 2003). Productivity increases in the traded-good sector seem to explain but a minor fraction of the observed real appreciation. The observed appreciation cannot be explained away by the traditional argument of external wealth accumulation (Lane and Milesi-Ferretti, 2000 and 2002) either. According to that hypothesis, countries with sizeable external liabilities need to run large trade balance surpluses to service those liabilities and positive net exports require by definition a "competitive," that is, depreciated real exchange rate.

Figure 2.2 Net Foreign Assets, FDI and Current Account Deficits



Note: All indicators are shown in percents of GDP. Data on stocks of net foreign assets, and FDI are not available for each period.
Data sources: NiGEM, National Central Banks, IMF BOP Yearbooks, Rider (1994).
Abbreviations: Czech Republic (CR), Hungary (HU), Poland (PO), Slovenia (SL), Greece (GR), Portugal (PT), Spain (SP).

Contrary to this theory, the four acceding countries have piled up external liabilities—their net foreign assets (NFA) were negative and increasing prior to the EU entry—and, at the same time, ran persistent current account deficits accompanied by real exchange rate appreciation. On average, their current account deficits were 4 percent of GDP between 1992 and 2003 and net foreign liabilities converged on average to nearly 30 percent of GDP. Frontrunners also learned to live with current account deficits, on average 4 percent of GDP between 1992 and 2003. However, during a run-up to the euro, their current

account deficits were approximately half the size of those in acceding countries, around 2.4 percent of GDP between 1992 and 1997 on average. Analogously to the case of acceding countries, frontrunners accumulated non-negligible net foreign liabilities, around 20 percent of GDP on average in 1997.

To sum up, one decade prior to adopting the euro, frontrunners appeared to fit similar patterns to those of acceding economies but at much smaller scales. Real exchange rates appreciated, NFA was negative, to some extent owing to FDI inflows, and countries run current account deficits. However, due to a larger scale of these patterns, the four acceding countries need to pay much closer attention to consequences of real appreciation for the economy, and to implications of their current account deficits for already decreasing NFA. The motivation given by the stylised facts can be simplified into the following two questions. First, is the volatile process of real exchange rate appreciation in the former transition countries over, making the fast EMU entry trivial, or is it likely to continue for a few more years, resulting in potentially costly adjustment in those countries? Second, is there an additional risk to sustainable economic developments due to currency misalignment if ERM II is introduced soon after the EU entry?

The post-adoption experience of the frontrunners has interesting repercussions for the acceding economies. First, the stock of net FDI declined following the adoption of euro. In 2003, it decreased to 5 percent of GDP on average. Should a similar FDI slowdown occur in the acceding countries, it would limit the expected integration gain, restricting real convergence. Second, current account deficits deepened and a growth in net foreign liabilities accelerated as a result. In 2003, frontrunners accumulated on average net foreign liabilities of 40 percent of GDP. This accelerated accumulation was possible in part because the stock of debt was relatively low prior to the euro adoption. However, the existing external debt is comparatively higher in the four acceding countries and any future increases are unlikely to be sustained, especially if the integration gain is less than what was expected by the financial markets.

3 The Model Framework

In this paper, the concept of fundamental real exchange rate (FRER) is used to analyse real exchange rates of acceding countries and of frontrunners. It has been developed to measure how far real exchange rates of acceding economies, converging to the EU economic level of development, are from values corresponding to their economic fundamentals and to project the sustainable path for their real exchange rates in the medium run. This section summarises benchmark studies in which the FRER concept is rooted. These studies work with various concepts of sustainable real exchange rates (SRERs). We call the whole group of alternative concepts "sustainable" real exchange rates since they all measure whether observed real exchange rates are (or will be) on a sustainable path regarding external balance. We point out important differences between the FRER and alternative concepts. In the second part, we describe the actual model used for the FRER computations.

3.1 Sustainable and Fundamental Real Exchange Rates

The concept of SRERs goes back to the research of Artus (1977). Since then new methodological and empirical studies emerge on a massive scale every time changes in exchange-rate regimes are debated. In the first half of 1990s, a new design of international exchange-rate system was debated among economists. It was also a period when unsustainable developments in various economies with fixed exchange-rate regimes were identified. These policy issues motivated an extremely rich branch of research. Barrell, Wren-Lewis (1989) computed fundamental equilibrium exchange rates for the G-7 group. Artis, Taylor (1993) proposed a concept of desired equilibrium exchange rates reflecting fiscal policy targets. Williamson (1994) compared several approaches to estimating equilibrium exchange rates. Stein, Allen (1995) described fundamental determinants of real exchange rates. MacDonald (1999) emphasised the distinction between long run and short run fundamentals.

In these benchmark studies, outcomes of computations are often called equilibrium real exchange rates. The adjectives such as fundamental, desirable and behavioural emphasise various methodological specifics. Alternative SRER concepts take different approaches to the role of economic policies and to the selection of economic fundamentals. SRERs also assume different concepts of equilibrium. Driver, Westaway (2003) explain how alternative methodologies work with different time horizons, the three main approaches being single-equation, often cointegration-based estimates, normative-target based models and general equilibrium models. They relate to short run, medium run and long run respectively. We suggest that medium-run concepts are most suitable for analysing real exchange rates in acceding countries, given their entry into the euro area will happen in a corresponding time span.

When international policy debate focused on acceding economies and their pre-EMU exchange-rate regimes, numerous empirical studies emerged that tried to asses real exchange rates of acceding countries. In his comprehensive survey, Égert (2003) quotes more than fifty studies related to the topic. They are all rooted in the previous stage of the policy debate about exchange-rate regimes, outlined above. The SRERs were initially estimated for industrial countries (Artis and Taylor, 1993; Feyzioğlu, 1997), and subsequently extended to developing countries (Elbadawi and Soto, 1997; Mongardini, 1998; and MacDonald and Ricci, 2003) and to the former transition economies (Halpern and Wyplosz, 1997; De Broeck and Sløk, 2001; Égert, 2002a and 2002b; Frait and Komárek; 2001, Rahn, 2003; and Spatafora and Stavrev, 2003). The FRER concept itself was first suggested in Šmídková, Barrell and Holland (2002). It has been argued that it reflects better some specific features of the former transition economies that were converging with a significant help of FDI and that were running relatively large current account deficits without exceeding safety limits for external indebtedness. The FRER model relies on the previous empirical work that focused on developing macro-models of acceding economies[3]. In this paper, the so-called "first-generation" FRER model is extended with a country specific definition of external balance and then newly applied to both acceding countries as well as

[3] Barrell et al (2002) describes the underlying macro-economic models estimated for the accession economies on panel data.

frontrunners.

The resulting SRER estimates depend to a large extent on the methodology chosen. It is worth keeping in mind that the FRER approach is comparable to the medium-run methodologies working with the macro-economic specification of real exchange rates[4] (Table 3.1). These normative-target based estimates originating in the work of Williamson (1994) search for a medium-term equilibrium that is unobservable from the actual data. According to this approach, real exchange rate can be driven by notional current account or external debt targets. These targets often reflect a general wisdom about levels of external debts and current account deficits that are sustainable. The wisdom also defines threshold values of deficits and debts that could trigger exchange-rate crisis. The medium-term SRERs are consistent with the internal and external balance of the economy but do not necessarily reflect the equilibrium on all asset markets since some of the markets do not clear in medium run due to various adjustment costs. As a result, stock variables, such as NFA and stock of FDI, are only converging to their long-term equilibrium levels. That is why their values can be only assessed in terms of sustainability, not in terms of equilibria.

In contrast, the short-run empirical approaches typically find smaller currency misalignments than medium-term approaches because they assume that the real exchange rate can be directly observed to return to its equilibrium value. They estimate deviations of real exchange rate from the short-run equilibrium that is mainly determined by financial markets. SRERs working with the long-term horizon typically estimate different signs of currency misalignment than medium-term SRERs. They are rooted in general equilibrium theory, and therefore, show the total impact of real convergence on real exchange rates in long run. However, dynamic general equilibrium models that usually underline the long-term SRERs cannot be used to compute levels of equilibrium real exchange rates because they work with deviations. A comparison of actual empirical results related to acceding countries that has been a part of our consistency check is provided in concluding section of this paper.

Table 3.1 Methodologies of Computing SRERs

Horizon Role of model	Short-term horizon	Medium-term horizon	Long-term horizon
Structural model, theory assumptions		FEER DEER FRER	NATREX PPP
Empirical estimates, Reduced forms, panels	NATREX * BEER		Large panels with long-term fundamentals

Notes: The alternative SRER concepts are explained in the following studies. Fundamental equilibrium exchange rates (FEER) in Williamson (1994). Desirable equilibrium exchange rates (DEER) in Artis, Taylor (1993). Fundamental real exchange rates (FRER) in Šmídková, Barrell and Holland (2002). Natural real exchange rate (NATREX) in Stein, Allen (1995). Purchasing power parity (PPP) in Williamson (1994). Behavioural equilibrium exchange rate (BEER) in MacDonald (1997). Example of a large-panel approach can be found in Halpern and Wyplosz (1997).
*) NATREX can be either estimated from a reduced form of an underlying model or computed directly from this model. In the first case, results are similar to the one of short-run approaches. The applications of the latter approach are relatively rare. For a recent application, see Detken et al (2002).

The medium-term SRERs are usually computed with the use of larger underlying macro-models. It is quite common to assume that the full employment line is vertical with respect to the real exchange rate and to compute SRERs from the trade equations of the underlying macro-model and from an added identity for external balance. The underlying model can be also used to produce scenarios for variables exogenous to trade equations. Due to different structures of the underlying models, alternative SRERs give emphasis to different economic fundamentals (Table 3.2). For example, the role of FDI is only

[4] Other methodologies work with sector specifications, based on relative prices of tradable and non-tradable goods. The sector approaches cannot be used for assessing relative price of domestic currency vis-à-vis euro and therefore are not included in our survey.

accentuated by the FRER model.

Table 3.2 Underlying Fundamentals of Medium-term SRERs

SRER concept Set of fundamentals	FEER	DEER	FRER
Trade factors (terms of trade, domestic and foreign demand)	√	√	√
International factors (world interest rate)	√	√	√
Internal balance (assumed vertical full-employment line)	√	√	√
External balance (CA target, debt target)	Current account target	Current account target	External debt target
Convergence factors* (factors of real appreciation)	Sustainable capital inflows	Sustainable capital inflows	Stock of FDI (integration gain)
Other policy relevant factors	x	Fiscal policy target	Initial level of debt

Notes: *) The so-called "convergence factors" are variables that help to explain why a relatively fast real appreciation of exchange rates and current account deficits can be sustainable. Specifically, if country obtains a significant portion of capital inflows that are evaluated by financial markets as sustainable, larger current account deficits are possible without increased risks of exchange-rate crisis. Analogously, an increasing stock of FDI implies that a host country can benefit from the so-called "integration gain", and consequently, from a stronger currency without additional costs.

There are two major differences between the FRER concept and other SRERs. The FRER defines the external balance in terms of stocks rather than flows and emphasises the role of FDI as the decisive factor in fundamental-based real exchange rate appreciation. Both characteristics are typical for acceding economies and are difficult to capture in other models. FRER employs a less binding definition of the external balance. Consequently, when FRERs are computed for acceding countries, current account deficits can be relatively high in the pre-EMU period when the catch-up process is likely to be at its fastest. However, temporarily larger deficits are only sustainable for those acceding economies that did not inherit the excessive stock of external debt. It is worth noting that FRER and other SRERs also depend on the international environment. A dramatic shock affecting international capital flows changes the path of the SRERs. This feature reflects well the experience of acceding economies that have already found out how big effect any international financial turbulence can have on their exchange rates.

As was said, the underlying model of the FRERs has been developed specifically for acceding economies. Small macro-models of the Czech Republic, Hungary, Poland and Slovenia have been incorporated into an existing global econometric model, NiGEM. NiGEM is a large-scale quarterly macroeconomic model of the world economy. The model is essentially New-Keynesian in its approach, in that agents are presumed to be forward-looking in some markets, but nominal rigidities slow the process of adjustment to shocks. Linkages between countries take place through trade, through interacting financial markets and through international stocks of assets. By incorporating the models of acceding countries into an existing global model, it is ensured that projections of all variables exogenous to the FRER model are consistent.

The role that FDI plays in the process of economic convergence is explicitly defined in the underlying NiGEM framework. FDI improves productivity of labour and it has a direct improving impact on trade balance, the so-called "integration gain". In addition, the stock of FDI increases the total share of external trade in GDP. FDI interacts with other variables in the underlying macro-model since the FDI inflow is endogenous to the system, increasing with lower relative labour costs and higher credibility of a host country. A theoretical model of FDI-driven real exchange rates shows that one can expect the FRER appreciation after an increase in the stock of FDI or a decrease in the initial stock of debt (Bulir and Smidkova, 2004). The small theoretical model, developed to underpin features of the second-generation FRER, is summarised in Annex 1.

3.2 The FRER Model

The FRER model is built around empirically estimated trade equations that relate exports and imports to the real exchange rate, the terms of trade, domestic and foreign economic activity. In addition, the process of real convergence is explicitly reflected in trade equations. Exports and imports are influenced directly by the stock of FDI and the integration gain improves trade balance. Second, current account deficits are not excessively restricted if the external debt is reasonably low. According to the theory, the overall impact of FDI on the trade balance should be an improving one ($\beta_3<\alpha_3$). However, it is important to test this hypothesis on data since the impact of FDI on the trade balance can differ from country to country and depends on whether the FDI require large-scale imports of technology and whether this technology is used to produce exported goods. In line with the available empirical work[5], the FRER model assumes that the stock of FDI (relative to GDP) is a significant driving force of the economic convergence in the acceding economies. The higher the stock of FDI, the higher is the economic integration, which in turn tends to promote trade and also to improve trade balance.

Exports are boosted with higher accumulated stock of FDI. Exports also expand when foreign demand increases, real exchange rate depreciates or terms of trade improve. For the sake of simplicity, the real exchange rate is defined in terms of relative import price in the model. Hence, relative price of exports is expressed with real exchange rate and terms of trade.

$$X = \alpha_0 \cdot \left(\frac{E.Pm}{P} \right)^{\alpha_1} \left(\frac{Px}{Pm} \right)^{\alpha_1} .S^{\alpha_2} .FDIS^{\alpha_3} \qquad (1)$$

where X is exports (index), E is the (dollar) nominal exchange rate, Pm is the effective price of imports, P is the domestic consumer price level, Px is the effective price of exports, S is foreign demand, and FDIS is the stock of FDI in real terms with respect to GDP. All parameters have positive values.

Imports expand when domestic economic activity increases or real exchange rate appreciates. Similarly to exports, imports increase with higher accumulated stock of FDI, but to a smaller extend due to the assumed integration gain.

$$M = \beta_0 \cdot \left(\frac{E.Pm}{P} \right)^{\beta_1} .Y^{\beta_2} .FDIS^{\beta_3} \qquad (2)$$

where M is imports (index), E is the (dollar) nominal exchange rate, Pm is the effective price of imports, P is the domestic consumer price level, Y is domestic output, and FDIS is the stock of FDI in real terms with respect to GDP. Parameters have positive values (only $\beta_1<0$) and $\beta_3<\alpha_3$.

The FRER model works with the assumption that there is a certain path for the external debt that is sustainable for a given economy and that this path can be approximated by considering the initial stock of debt and the so called "debt target" for the end of the simulation period. The debt target specifies which debt-to-GDP ratio is sustainable for the economy in the medium run. Since it is not possible to determine the optimal level of external debt within the FRER model, the definition of external balance should be viewed as a normative concept. For example, one can assume that acceding countries do not wish to exceed safety limits announced by international financial analysts in order to avoid any costly turbulence of their currencies[6].

[5] Holland and Pain (1998) study determinants and impact of FDI in Central and Eastern Europe.

[6] The importance of not exceeding the safety limits was confirmed by several experiences of acceding countries. For example, see Smidkova et al (1998) for the analysis of the Czech experience with the 1997 koruna turbulence.

$$D^{*} = \delta \left[D_{0}, D_{T} \right] \quad (3)$$

where D is the sustainable path of net external debt (in domestic currency, in real terms, with respect to GDP). A function δ extrapolates between the initial level of external debt D_0, given by the data, and the debt target for the end of the simulation period D_T.*

A path of FRER is obtained by solving equations (1)–(3) for a selected simulation period. Given the assumed interactions of domestic trade with the international environment and the scenarios for exogenous variables, FRERs reflect the following economic fundamentals: the terms of trade, world interest rates, domestic and foreign activity, the stock of FDI and the initial level of (net) external debt. In addition, FRERs ensure that the constraint on external debt, given by the debt target, is met in the end of simulation period.

$$\left\{ \overline{M}.\beta_0.(FRER)^{\beta_1}.Y^{\beta_2}.FDIS^{\beta_3} - \overline{X}.a_0.(FRER)^{a_3}.\left(\frac{Px}{Pm}\right)^{\alpha_1}.S^{\alpha_2}.FDIS^{\alpha_3} \right\} = (1-r).D^{*}.Y - D_{-1}^{*}.Y_{-1} \quad (4)$$

where FRER is the fundamental real exchange rate, $\overline{M}$ is the volume of real imports in the base year, $\overline{X}$ is the volume of real exports in the base year, and r is the real interest rate abroad. Other variables are described by equations (1)-(3).

Although the real exchange rate takes the stage in the FRER model, the indications of currency misalignment should not be viewed as a direct consequence of exchange-rate policy alone. Differences between FRERs and observed values of real exchange rates are often outcomes of a combination of various events, some of them domestic and some international. Analogously, rescue remedies should not be expected from changes in the exchange-rate strategy itself. For example, massive FDI inflows attracted by credible domestic economic reforms or permanent changes in terms of trade may be sufficient to solve the problems. For that reason, we suggest to use the FRER model in order to produce indicators rather than to use it to wheel the exchange-rate policies. The latter approach has been also sometimes debated. Specifically, the issue of whether desired exchange rate system should ensure internal and external stability or whether policies should be designed to create the internal and external conditions under which the desired equilibrium naturally emerges was discussed (Williamson, 1994).

4 Computations

The FRER indicators are computed in two stages. First, a baseline path for the FRER is computed. The FRER model is calibrated according to results of previous empirical work on acceding countries. We add a new country-specific definition of external balance to improve the first-generation FRER model. Second, the so-called FRER corridors are computed that reflect uncertainty related to the baseline computations. Afterwards, two indicators are constructed for each country. First, an indicator of currency misalignment sends a warning signal if observed real exchange rate deviates from the FRER corridor. Second, a sustainability chart compares the FRER corridor with the so-called "stability" corridor. If the two corridors do not overlap in the medium run, stability of inflation and exchange rate might be difficult to sustain simultaneously in the forthcoming period. Surprisingly, this issue has not been addressed in previous research.

4.1 Model Calibration and Baseline Computation

Parameters of the FRER model have been calibrated according to results of the previous empirical work[7]. Specifically, long-term parts of trade equations estimated from panel data that form trade blocs in the macro-econometric models of acceding economies in NiGEM have been taken into account (Table 4.1). The estimates of the trade elasticities with respect to FDI are comparable to estimates for Ireland and estimates for the UK, Germany, France, Sweden and the Netherlands[8] while estimated elasticities of export with respect to the real exchange rate are somewhat higher for acceding economies. According to the estimates, the integration gain is ensured by FDI inflows that improve trade balance. The data panel included all four acceding countries. We then apply the same parameters to the group of frontrunners in order to ask what kind of real exchange rate performance would one expect at the time of their entry into the ERM II supposing an identical macroeconomic framework was applied to them[9].

Table 4.1 Model Calibration

	Parameter	Value
$\alpha 1$	Export elasticity to real exchange rate	3.15
$\alpha 2$	Export elasticity to foreign demand	1.00*
$\alpha 3$	Export elasticity to stock of FDI	0.7
$\beta 1$	Import elasticity to real exchange rate	-0.62
$\beta 2$	Import elasticity to domestic output	1.00*
$\beta 3$	Import elasticity to stock of FDI	0.24

Note: Parameters are taken from Smidkova, Barrell, Holland (2002). Parameter values labelled with (*) were imposed during the estimations.

The first-generation FRER model (Smidkova, Barrell, Holland, 2002) worked with the assumption that a targeted external debt should equal to 60 percent of GDP in each country. This value corresponded to the safety limit quoted often by private financial institutions. Ades, Kaune (1997) illustrate that a safety limit for the current account deficit was often used by foreign investors to evaluate their investment positions. The safety limit was usually set by a rule of thumb, typically equal to 4 percent of GDP. Analogously, the rule of thumb was developed for external debt, between 50 and 60 percent of GDP.

[7] Macro-econometric models are described in Barrell, Holland, Jakab, Kovacs, Smidkova, Sepp, Cufer (2002). Estimates of trade equations are explained in Smidkova, Barrell, Holland (2002).

[8] See Barrell, te Velde (2000) and Pain, Wakelin (1998) for a comparison.

[9] A similar approach although applied within a different modelling technique is suggested in Maeso-Fernandez, Osbat and Schnatz (2004).

In this paper, we try to reflect more recent findings that pointed out that the rule of thumb may not be suitable for all emerging economies. Specifically, IMF (2002) provides empirical evidence that when debt crises or corrections occur, external debt ratio is typically below 50-60 percent of GDP and that sustainable levels of debt depend on country-specific characteristics (Table 4.2). The higher the export share in GDP is, the higher the threshold, triggering crisis, can be. In order to reflect these findings, the FRER model in this paper works with a country–specific definition of external balance. We use the same assumptions for our group of frontrunners although it should be kept in mind that financial markets may apply more generous safety limits once the euro is adopted[10]. Since the post-adoption experience of frontrunners is not subject of this study, we leave this question open for further research.

Table 4.2 External Debt Targets

	S&B&H	IMF 2002
Benchmark	60	50-60
Czech Republic	*Benchmark applied as a rule of thumb to all cases*	65 (X/Y>40)
Hungary		65 (X/Y>40)
Poland		53 (X/Y>30)
Slovenia		65 (X/Y>40)
Greece	X	53 (X/Y>30)
Portugal	X	53 (X/Y>30)
Spain	X	53 (X/Y>30)

Note: Debt targets defined in percent of GDP. Targets used for the 1st generation FRER (S&B&H) are described in Smidkova, Barrell, Holland (2002). Targets used for the 2nd generation FRER (IMF 2002) have been derived from the estimates presented in the IMF study (IMF, 2002). X/Y is a ratio of exports to GDP that indicates openness of the economy and a capacity of the economy to repay debts.

For each country, FRERs are computed by solving the model using Winsolve simulation package, the Newton method[11]. A solution period goes from 1992 to 2022 when external debts converge to their targeted values. Variables exogenous to the FRER model are defined according to standards of the NiGEM database (See Annex II). Off-sample projections of both domestic as well as external variables, representing international context, are produced with the NiGEM framework[12]. This is possible because – as was said - all analysed countries are represented with their own country models. The consistent framework ensures that domestic demand, aggregate supply and the external sector are linked together in the underlying models through the wage-price system, wealth and competitiveness.

We present our results in two different time spans. The first time span (1995-2010) relates to acceding countries. The FRERs are computed both in-sample (1995Q1–2003Q4) as well as off-sample (2004Q1–2010Q4). In this time span, acceding countries finished their preparations for the EU entry and they plan to introduce ERM II, and later on, adopt euro. The second time span (1992-2003) tracks the experience of frontrunners with preparations for the euro adoption. The Portuguese escudo, and Spanish peseta entered ERM II in 1996, whereas the Greek drachma in 1998. Following the two-year period of nominal-convergence assessments, these countries adopted euro in 1999 and 2001, respectively. Last three years of the 1992-2003 period illustrate the post-adoption experience of frontrunners. In the case of frontrunners, all computations are done in-sample.

[10] We would like to thank to the participants of the ECB seminar for pointing out that there could be a shift in safety limits after the euro adoption.

[11] For more information about the Winsolve package, see http://www.econ.surrey.ac.uk/winsolve/.

[12] Information about the National Institute Global Econometric Model (NiGEM) can be found on http://www.niesr.ac.uk/models/nigem/nigem.htm.

4.2 Computing FRER and Stability Corridors

As with other indicators, the computations of currency misalignment and sustainability charts are useful only if they include information about the robustness of results. We performed extensive sensitivity tests in order to compute confidence bands both for in-sample and off-sample (projection) periods (Table 4.3). While in-sample confidence bands are obtained from the estimation errors of trade equations, off-sample confidence bands include as well historical standard errors of variables exogenous to the FRER model and approximation of uncertainty about the targeted value of external debt. When approximating the debt target, we take into account empirical findings about threshold values, triggering crisis, that were summarised above. These findings suggest that uncertainty related to the debt target is at least 10% of GDP[13]. The confidence bands related to the FRER computations are of a similar order compared to other studies on SRERs[14]. A further robustness check is presented in concluding section where our results are compared vis-à-vis other recent studies.

Table 4.3 Sensitivity Analysis: Confidence Bands

FRER Component	Sources of uncertainty	
	In-sample computations	Off-sample computations
World interest rate	Non (OD)	1 pp (AV)
Domestic output	Non (OD)	1% (AV)
Import equation	Country specific (SE)	
Terms of trade	Non (OD)	2% (AV)
Export equation	Country specific (SE)	
Foreign demand	Non (OD)	5% (AV)
Stock of FDI (% of GDP)	Non (OD)	10 pp (AV)
Debt target	± 5% of GDP (according to the benchmark estimates)	

Note: If data are observable (OD), there is no additional uncertainty attached to the model uncertainty resulting from exogenous variables. For off-sample projections, the average volatility of data series (over period 1992-2003 across countries) is taken to calibrate the scale of uncertainty (AV). For the whole simulation period, the country-specific uncertainty related to estimations is considered based on standard errors of estimated trade equations (SE). The interval of benchmark estimates of sustainable debt levels is calibrated according to findings presented in Table 4.2.

Indicators of currency misalignment are constructed by comparing the observed values of real exchange rates with the computed FRERs and with in-sample confidence bands. Sustainability charts compare the FRER corridors with the stability corridors. The FRER corridors show confidence bands around the baseline values of the FRERs, in-sample bands for frontrunners and both in- and off-sample bands for acceding countries. The widths of these bands differ according to specific features of individual economies. For example, the FRER corridor for Hungary is typically wider than corridors of other acceding countries due to larger estimation errors in the panel-based trade equations. The stability corridors examine sustainability of meeting Maastricht convergence criteria for inflation and exchange-rate simultaneously. Due to various interpretations of the exchange-rate stability, we compute two alternative stability corridors for each acceding country[15]. In both cases, stability corridors assume that exchange rate vis-à-vis euro is fixed in 2004 in acceding countries. For frontrunners, the date of the

[13] Smidkova, Barrell, Holland (2002) show that the FRERs are not over-sensitive to the definition of the debt target. Hence, a relatively large uncertainty related to the sustainable path of the debt does not imply that it is not possible to compute FRERs.

[14] Williamson (1994) and Bayoumi, Clark, Symansky, Taylor (1994) report similar estimates of the uncertainties pertaining to computations of equilibrium real exchange rates. Detken, Dieppe, Henry, Marin, Smets (2002) estimate the uncertainty specifically for the equilibrium real exchange rates of the euro at around 20%.

[15] ERM2 permits nominal exchange rate fluctuations within a ±15 percent band. This requirement differs from the exchange rate stability criterion, sometimes quoted, which requires "observation of normal fluctuation margins provided by the exchange-rate mechanism of the European Monetary System, for at least two years, without devaluing against the currency of any other Member State" (Article 121(I) of the Maastricht Treaty). Specifically, the criterion was set as fluctuation margins of ±2¼ percent against the median currency.

actual ERM II entry are known, and hence, they can be used for computing the stability corridors. The third alternative definition of the stability corridor applies to the post-adoption period. After adopting the euro, not only frontrunners keep their nominal exchange rates fixed vis-à-vis euro - in addition, they should have inflation rates close to the ECB definition of price stability[16]. Otherwise, there is an increased risk of various imbalances emerging in the frontrunners' economies. The third type of stability corridors illustrates that. The width of these corridors reflects uncertainty related to the definition of price stability.

5 Results

We summarise empirical results in three subsections. First, we show a measure of currency misalignment for the Czech koruna, Hungarian forint, Polish zloty, and Slovenian tolar prior to the EU entry. Second, we present a forward-looking measure of real exchange rate stability for the four acceding countries in the run-up to the euro adoption. Third, we provide the same measure of real exchange rate stability for the three frontrunners, Greece, Portugal, and Spain, computed *ex post* for a period prior to their entry into the euro area.

Our findings suggest that if all four acceding countries were to enter into ERM II in 2004 at current exchange rates and try to meet Maastricht criteria as well, it may do them more harm than good. At present, all currencies but the tolar seem to be overvalued and estimated speed of FRER appreciation is not high enough to compensate for that currency misalignment in short run. Hence, currencies are likely to remain overvalued for a considerable period of time if countries race to the euro without considering their specific conditions. If central parity is specified at a weaker-than-market rate in order to prevent problems of overvalued currency, meeting the inflation criterion may not be feasible. The estimated speed of FRER appreciation signals that corrective revaluation of central parity may be required to avoid inflationary consequences of the initial devaluation. Our empirical findings are consistent with a recently published policy suggestion that acceding countries might benefit from maintaining their pre-EU exchange-rate regimes some time after the EU entry (Backé et al, 2004).

Frontrunners' smooth sailing into the euro area should not be taken as an assurance of a similar performance for the acceding countries. We are sceptical, both because the initial currency misalignment as well as prospects of real exchange rate stability prior to the euro adoptions were more favourable in the frontrunners' group. Also, the frontrunners entered ERM II during periods of relative tranquillity in international financial markets. Acceding countries may not be as lucky.

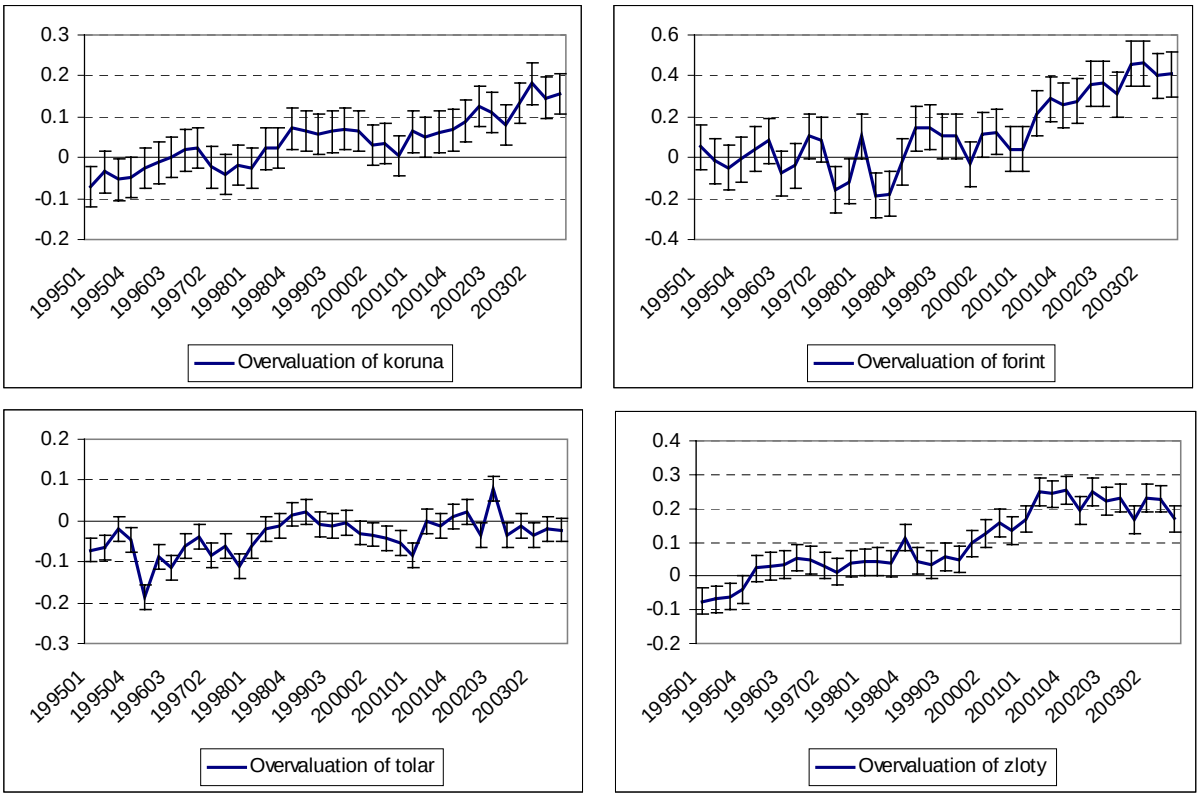
5.1 Currency Misalignment Prior to the EU Entry

According to the FRER model, three acceding currencies were significantly overvalued in 2003 (Figure 5.1). Fixing the euro conversion rates at the 2004 exchange rates would have posed a major problem for the forint, zloty, and koruna (in that order), but not for the tolar. These rates would not have corresponded to economic fundamentals captured by the FRER model and subsequent external imbalance could disrupt nominal convergence. On average, economic fundamentals explained about 60 percent of real appreciation during the last decade. The remaining part reflects perhaps too optimistic expectations about the speed of real convergence in acceding countries, temporary impact of the privatisation inflows and the psychological effect of the forthcoming EU enlargement that determined short-term equilibria on financial markets. The impact of financial markets on currency misalignments was specially evident when monetary policy strategies were changed and financial markets had their say after periods of watching passively the exchange rates, fixed by domestic authorities. Koruna was

[16] However, five years after euro adoption, not all members of the Euro Area have managed to maintain inflation at that desired level. Angeloni and Ehrmann (2004) discuss the problem of prevailing inflation differentials within the Euro Area. They find that among several potential causes inflation differentials inflation persistence plays a dominant role, other causes being differences in monetary transmission or asymmetric shocks.

let to float in 1997, zloty in 1999 and forint in 2001. Interestingly, Slovenia is the only acceding country in our sample that did not rely on the exchange-rate stabilisation in the period of economic transition. In 2003, partial corrections of the previous excessive real appreciation trend took place and real exchange rates reflected better medium-term prospects of acceding countries.

Figure 5.1 Overvaluation of Currencies in 2003: Acceding Countries



Note: The computed misalignments of real effective exchange rates are reported as index values. For example, the indicator's value 0.1 implies overvaluation of 10 percent. The attached confidence bands reflect an underlying uncertainty of computations.

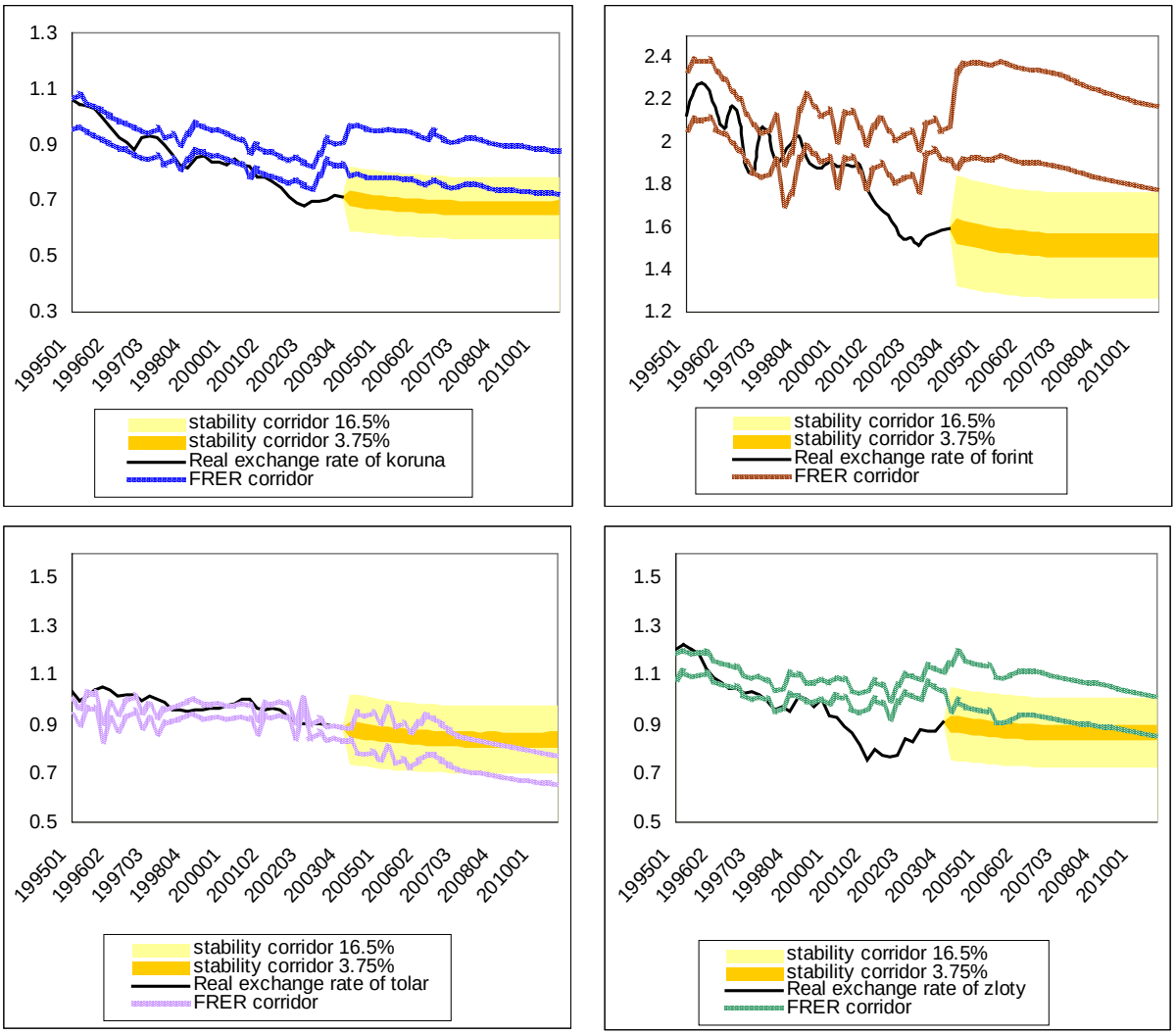
The Czech koruna went through a period of minor real undervaluation during 1995-1996. After a currency turbulence in 1997-1998, the exchange rate appreciated sharply in 1999. Resulting overvaluation of 5 percent increased to about 15 percent in 2003. In 2003, the misalignment was corrected to some extent with a nominal depreciation, but low inflation kept koruna overvalued. The confidence band is narrow at ±5 percent. The Hungarian forint avoided overvaluation until 2000. During 2001-2002 period, sharp real appreciation led to a massive currency misalignment of some 40 percent that was subsequently to some extent corrected in late-2003. The confidence band is wide at ±11 percent. The Polish zloty was marginally overvalued for several years until early-2000. Subsequently, a gradual real appreciation led to misalignment of some 15-25 percent in 2002. In 2003, zloty started depreciating and misalignment was gradually reduced to 17 percent. The confidence band is narrow at ±4 percent. The Slovenian tolar seemed to be in line with economic fundamentals in 2003 after a protracted period of real undervaluation. The confidence band is the narrowest at ±3 percent.

5.2 Sustainability of Nominal Convergence After the EU Entry

In the period 2004-2010, computed FRERs show a continuing tendency of real appreciation in all four acceding countries as a result of progressing real convergence (Figure 5.2). According to constructed sustainability charts, nominal convergence required by the Maastricht criteria and ERM II may prevent currencies of the acceding countries from converging towards their medium-term equilibrium values. Due to potential external imbalances, it may not be feasible to meet the official criteria of nominal

convergence soon after the EU entry without increased risks of unsustainable developments in medium run. It is worth noting that although our sample of acceding countries is relatively small, analysed countries do not face identical problems. On one hand, the forint´s FRER is likely to remain well above the broader ±15 percent stability corridor. Assuming that exchange-rate and monetary policies keep real exchange rate within the stability corridor, the depreciation required to reach external balance is not a viable option. On the other hand, the tolar may need a modest revaluation toward the end of this decade.

Figure 5.2 Sustainability Charts: Acceding Countries



Note: The 2004Q1 value of the koruna's real effective exchange rate has been used as a starting point for computations of stability corridors. Stability corridors illustrate which path of the real exchange rate is compatible with the nominal convergence criteria, given the nominal exchange rate can fluctuate within either narrow bands (2.25%) or within the broader bands (15%). The FRER corridor reflects the baseline FRER and estimated uncertainty.

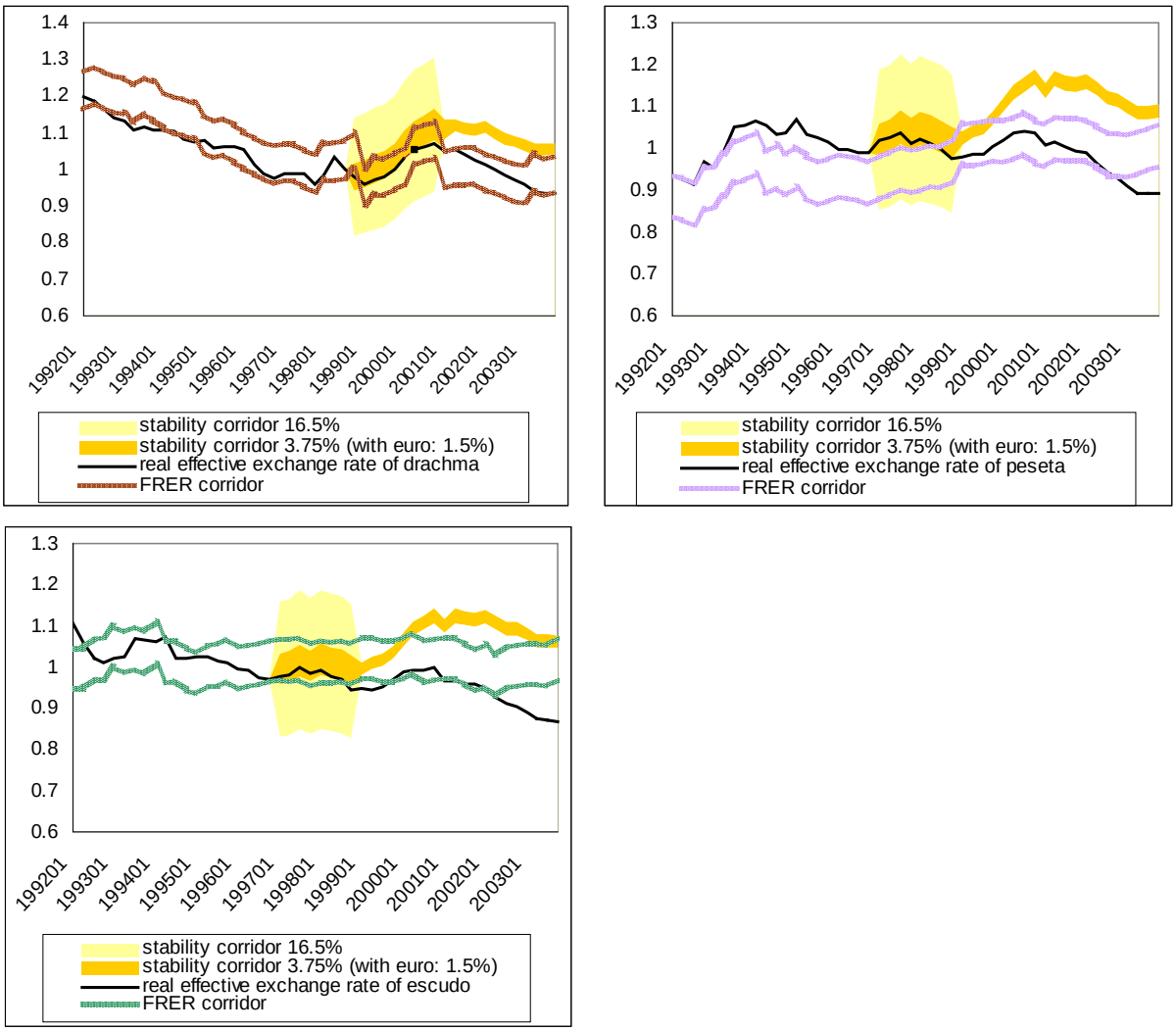
The Czech koruna is likely to remain overvalued after the EU entry if nominal exchange rate and inflation develop in line with nominal convergence criteria. Real appreciation that is in line with economic fundamentals will not be fast enough to compensate for the 2003 overvaluation. Only around 2007 could real exchange rate restore external balance if koruna can fluctuate within the ± 15 percent bands. The Hungarian forint is far away from its medium-term equilibrium. During 2004-2010 nominal convergence and external balance are found incompatible. The Polish zloty follows similar pattern to koruna during 2004-2010, only on a shorter time span. In the short-term, nominal convergence criteria will be too restrictive to bring the Polish currency in line with external balance. Around 2007, zloty can fluctuate within the ±2.25 percent bands and be compatible with external balance. This finding implies that nominal convergence may be sustainable sooner than in the Czech case. The Slovenian tolar might

need revaluation of up to 10 percent around 2010. During 2004-2010, nominal convergence appears sustainable with respect to external balance in the Slovenian case.

5.3 Experience of Frontrunners

We compare the FRERs of four acceding countries computed for 2004-2010 period to those of three frontrunners (Greece, Portugal and Spain) computed for period 1992-2003. The 1992-2003 period covers their seven-year experience of preparing for euro as well as a brief post-adoption period. If acceding countries adhere to their pre-announced schedules of the euro adoption, they have less than seven years to prepare for euro after the EU entry. We can see from the frontrunners' experience if their smooth sailing into the euro area can be taken as an assurance of a similar performance for the acceding countries. We find that, first, frontrunners started their testing period with fundamentally correct parities vis-à-vis the euro and, second, prior to euro adoption their ERM II parities seemed sustainable for the period ahead (Figure 5.3).

Figure 5.3 Sustainability Charts: Frontrunners



Note: Prior to the euro adoption, stability corridors illustrate which path of the real exchange rate is compatible with the nominal convergence criteria, given the nominal exchange rate can fluctuate within either narrow bands (±2.25 percent) or within the broader bands (+15 percent). After the euro adoption, stability corridors illustrate which real exchange rate is compatible with the ECB definition of price stability. The FRER corridor reflects the baseline FRER and estimated uncertainty.

If anything, the peseta was slightly undervalued in 1993-1998 period. Following the euro adoption, the real exchange rate remained broadly in line with Spanish economic fundamentals until 2003. However,

the real appreciation was stronger than would have been required by Maastricht inflation criterion. The drachma was in line with economic fundamentals in 1992-2003 period according to the FRER model. The escudo remained in line with economic fundamentals until 1999 although it was closer to overvaluation than drachma. According to the FRER model, the euro was some 10-20 percent too strong in real terms for Spain and Portugal in the end of 2003.

6 Concluding Remarks

The computed fundamental real exchange rates for acceding countries and frontrunners suggest that three of the analysed acceding countries (the Czech Republic, Hungary, and Poland) are likely to experience difficulties during their stay in the ERM II if they were to introduce it too soon after the EU entry. Frontrunners' smooth sailing into the euro area should not be taken as an assurance of a similar performance for the acceding countries. The following four conclusions are worth highlighting.

First, we find that all analysed currencies but the Slovenian tolar were overvalued in 2003. This finding corresponds to results of other studies that have recently estimated currency misalignments in acceding countries and used comparable, medium-term, methodologies (Table 6.1)[17]. At the first sight, a comparison of all available empirical results that are related to real exchange rates in acceding countries gives a somewhat mixed picture. Results may even seem contradictory. However, all studies based on medium-term methodologies gave similar warning signals regarding currency misalignment for the Czech Republic, Hungary, and Poland. On the other hand, the long-term approaches (Égert, 2003) concluded that the national currencies were undervalued prior to the EU entry and that equilibrium real appreciation would continue for some considerable period of time. The short-term approaches (Frait and Komárek, 2001, C ,2003, and Coudert and Couharde, 2002) found real exchange rates of acceding countries quite close to their equilibrium values.

Table 6.1 Recent Estimates of Currency Misalignment

Country Outcome	Czech Republic	Hungary	Poland	Slovenia
Overvalued more than 10%	S&B (FRER)	S&B (FRER) S&B&H (FRER) C (FEER)	S&B (FRER) S&B&H (FRER)	
Overvalued less than 10%	C&C (FEER) S&B&H (FRER)	C&C (FEER) *C (BEER)*** *C (NATREX)***	C&C (FEER) R (FEER)	C&C (FEER)
In line with fundamentals	*F&K (BEER)***			S&B&H (FRER) G&K (FEER)
Undervalued less than 10%	*F&K (NATREX reduced form)***			S&B (FRER)
Undervalued more than 10%	*E (PPP)**	*E (PPP)**	*E (PPP)**	*E (PPP)**

Notes: This table compares recent estimates of currency misalignment in acceding countries, mostly from 2001-2003. Medium-term methodologies have been recently applied, for example, in the following studies [abbreviations in parenthesis]. Smidkova, Barrell and Holland, 2002 [S&B&H]. Coudert and Couharde, 2002 [C&C]. Genorio and Kozernik, 2003 [G&K]. Rubaszek, 2003 [R]. This paper [S&B].

*) Long-term methodologies have been recently applied, for example, in the following study. Égert, 2003 [E].

**) Short-term methodologies have been recently applied, for example, in the following study. Csjabók, 2003 [C]. Frait and Komarek, 2001 [F&K].

Once methodological differences are accounted for, the picture about currency misalignments in acceding countries gets a bit clearer. The time horizon of a selected methodology plays an important role in computations of equilibrium real exchange rates since short-, medium- and long-run equilibria are not identical (Driver and Westaway, 2003). Short-term methodologies find real exchange rates closer to their equilibrium values than medium-term approaches because they search for misalignment from the perspective of financial markets. The same conclusion sometimes holds for medium-term

[17] Interestingly, in a comparable time span, estimates of the equilibrium value of the real effective euro exchange rate (Detken et al, 2002) suggested a mild undervaluation of euro.

methodologies that calibrate normative targets in line with observed values of current account deficits. On the contrary, the long-term methodologies estimate the scope for further real appreciation after all constrains, including the one imposed by financial markets on external debt, are removed completely and after transition towards equilibrium on all goods and asset markets is over. To some extent, long-term methodologies give results analogous to our sustainability charts. Due to convergence process, the real exchange rates of acceding economies might not be as stable as they should be according to nominal convergence criteria.

Secondly, we would like to highlight that the empirical literature to date has not focused very much on the issue of real exchange rate stability in the run-up to the euro adoption. Égert (2002b) concluded that real exchange rate volatility is not likely to pose a problem and that accession countries should enter the ERM II as quickly as possible. Šmídková *et al*. (2002) are much less optimistic, foreseeing volatility related to the underlying fundamentals and real convergence. Forward-looking computation of the FRERs through 2010 indicates that the currencies of acceding countries are unlikely to stay within the stability corridors if real exchange rates converge to their equilibrium levels. Pursuing the convergence criteria too soon after the EU entry may prevent the Czech, Hungarian, and Polish economies from maintaining external balance. In contrast, the Slovenian currency may require sizeable revaluation prior to the euro adoption. *Ex post* simulations for those countries that accepted the euro in the late 1990s, Greece, Portugal, and Spain, show no currency misalignment at the time of introducing the ERM II. Moreover, after introducing the ERM II, their real exchange rates followed a more stable, medium-term path than what can be expected in the acceding countries.

Our third conclusion relates to differences among the acceding countries. Although our sample consists of only four acceding countries, we have been able to detect different problems regarding the compatibility between nominal convergence criteria and underlying economic fundamentals during the forthcoming period. On one hand, for some countries, currency misalignment can pose a serious problem. On the other hand, other acceding economies may succeed with a gradual revaluation strategy. Analogously, forward-looking analysis sends a warning signals only to some countries that may not be able to maintain external balance and at the same time meet nominal convergence criteria, no matter how softly the exchange-rate bands of the ERM II are interpreted. On the contrary, for some acceding countries, the actual interpretation of the exchange-rate stability may play an important role.

Fourth, following the euro adoption, convergence problems will not disappear. Should a slowdown of FDI inflows materialise — as observed in the case of frontrunners — convergence might decelerate in acceding countries. It would remain to be seen whether domestic investment would be sufficient to pick up the slack. Moreover, it is unclear whether the acceding countries will be able to accumulate foreign liabilities at a sufficient speed, given their already relatively high levels of external indebtedness. Their position in this respect is different from the one of frontrunners who could afford a further external debt accumulation. For the above-metniond reasons, an early “race to the euro” appears to be a costly competition, indeed.

ANNEX 1

The Model of FDI-Driven Real Exchange Rates

Consider a small, open economy described by standard money- and goods-equilibrium schedules, a classical production function, and the uncovered interest parity relationship:

LM $$m - p = \alpha y - \beta R \quad \text{(A1)}$$

IS $$y = \gamma \dot{k} + \delta c + \psi g + \lambda y^* + \rho f \quad \text{(A2)}$$

Classical production function) $$y = \varepsilon k, \quad \text{(A3)}$$

where $k \equiv i + f$, that is, capital stock, *k*, is composed of "domestic" capital, *i*, and "foreign" capital, *f*, both of which have identical productivity.

Uncovered interest parity $$\dot{e} = R - R^*, \quad \text{(A4)}$$

and hence in real terms: $\dot{c} = r - r^*$.

Capital accumulation schedule $$\begin{cases} k < k^* \Rightarrow \dot{k} = \alpha t - \theta r - \phi k - \eta d \\ k \geq k^* \Rightarrow \dot{k} = \varpi t - \theta r - \phi k - \eta d \end{cases} \quad \text{(A5)}$$

Debt accumulation schedule $$d = \bar{d} - \mu y + \kappa f + \iota g \quad \text{(A6)}$$

where *m* is money supply; *p* is the price level; *y* and *y** are domestic and world output, respectively; *R* and *R** are domestic and world nominal interest rate, respectively; *k* is the stock of capital; *c* is the real exchange rate; *g* is the fiscal impulse; *f* is foreign direct investment; *d* is the real stock of total debt, both public and private; $\bar{d}$ is an initial level of real debt; and *t* is time. Greek characters denote positive and fixed parameters (all smaller than one) and variables with a star denote world variables. All lower-case variables are in logarithms. The model has the following exogenous variables: *p*, R*, g, y*, f,* $\bar{d}$, and *t*; endogenous variables: *y, m, R, e, p*, and *d*; and state variables: *c* and *k*, where *c* is the driving (jump) variable and *k* is the predetermined variable.

Substituting from the LM schedule into the uncovered interest parity we obtain:
$\dot{e} = \frac{1}{\beta}(\alpha\varepsilon k - m + p) - R^*$ and rearranging the IS schedule yields:
$\dot{k} = \frac{\varepsilon}{\gamma}k - \frac{\delta}{\gamma}c - \frac{\psi}{\gamma}g - \frac{\lambda}{\gamma}y^* - \frac{\rho}{\gamma}f$. From the capital accumulation schedule we find the expression for the real interest rate in transition and advanced countries, respectively:

$$r = -\frac{1}{\theta}\left[\dot{k} - \alpha t + (\phi - \eta\mu\varepsilon)k + \eta\bar{d} + \eta\kappa f + \eta\iota g\right]$$

and

$$r = -\frac{1}{\theta}\left[\dot{k} - \varpi t + (\phi - \eta\mu\varepsilon)k + \eta\bar{d} + \eta\kappa f + \eta\iota g\right].$$

Finally, substituting for *r* and $\dot{k}$ in the real exchange rate relationship we obtain for the transition country:[18]

$$\dot{c} = \left(-\frac{\varepsilon}{\gamma\theta} - \frac{\phi}{\theta} + \frac{\eta\mu\varepsilon}{\theta} \right) k + \frac{\delta}{\gamma\theta} c - \frac{\eta}{\theta} \bar{d} + \left(\frac{\psi}{\gamma\theta} - \frac{\eta\iota}{\theta} \right) g + \frac{\lambda}{\gamma\theta} y^* + \left(\frac{\rho}{\gamma\theta} - \frac{\eta\kappa}{\theta} \right) f + \frac{o}{\theta} t - R^* .$$

The state-variable relationships can be expressed in a matrix:

$$\begin{bmatrix} \dot{c} \\ \dot{k} \end{bmatrix} = \begin{bmatrix} \frac{\delta}{\gamma\theta} & \frac{\gamma\eta\mu\varepsilon - \varepsilon - \gamma\phi}{\gamma\theta} \\ -\frac{\delta}{\gamma} & \frac{\varepsilon}{\gamma} \end{bmatrix} \begin{bmatrix} c \\ k \end{bmatrix} + \begin{bmatrix} \frac{\rho - \gamma\eta\kappa}{\gamma\theta} & \frac{\psi - \gamma\eta\iota}{\gamma\theta} & -\frac{\eta}{\theta} & \frac{\lambda}{\gamma\theta} & \frac{o}{\theta} & -1 \\ -\frac{\rho}{\gamma} & -\frac{\psi}{\gamma} & 0 & -\frac{\lambda}{\gamma} & 0 & 0 \end{bmatrix} \begin{bmatrix} f \\ g \\ \bar{d} \\ y^* \\ t \\ R^* \end{bmatrix}$$

The determinant of the Jacobi matrix is negative $\left(\Delta = -\frac{\delta\psi}{\gamma\theta} + \frac{\delta\eta\mu\varepsilon}{\gamma\theta} < 0 \right)$ as long as the output effect of a fiscal shock is large compared to the indirect output effect of a capital stock shock through the output-debt nexus $(\psi > \eta\mu\varepsilon)$. Hence, the solution to the dynamic system is a saddle point with the usual properties and the motivation of a "rational-expectations" equilibrium.[19]

We can easily obtain the slopes of the exchange rate and capital stock stationary lines:

$$\left. \frac{dk}{dc} \right|_{\dot{c}=0} = \frac{\delta}{\varepsilon + \gamma\phi - \gamma\eta\mu\varepsilon} > 0 \quad \text{and} \quad \left. \frac{dk}{dc} \right|_{\dot{k}=0} = \frac{\delta}{\varepsilon} > 0 .$$

Under the assumptions spelled out earlier, the absolute value of the latter one is larger and, hence, $\dot{k} = 0$ is flatter as compared to the former $(\delta/\varepsilon > \delta/(\varepsilon + \gamma\phi - \gamma\eta\mu\varepsilon))$. From the Jacobi matrix we determine that he only convergent path under the saddle-path solution is along the dashed line.

The schedule shifts as a result of the FDI and debt shocks, respectively, that were mentioned in the text are:

$$\left. \frac{\partial c}{\partial f} \right|_{\dot{c}=0} = \frac{\gamma\kappa\eta - \rho}{\delta} < 0 \quad \text{and} \quad \left. \frac{\partial c}{\partial f} \right|_{\dot{k}=0} = -\frac{\rho}{\delta} < 0 , \text{ and}$$

$$\left. \frac{\partial c}{\partial \bar{d}} \right|_{\dot{c}=0} = \frac{\gamma\eta}{\delta} > 0 \text{ and } \left. \frac{\partial c}{\partial \bar{d}} \right|_{\dot{k}=0} = 0 .$$

[18] For simplicity, we show only the solution of the transition-country version of the model.

[19] Strictly speaking, given the presence of time in our capital accumulation schedule, the equilibrium point shifts over time. For the sake of simplicity, we ignore this issue.

ANNEX 2

Data Issues

Data and projection consistency is crucial for FRER calculations, given the endogenous relationship between various variables, such as domestic and foreign demand or trade and financial flows. We rely on the global econometric model (NiGEM) maintained by the National Institute of Economic and Social Research. The NiGEM allows us to project all variables that are exogenous to the FRER model - domestic and external - within the same model framework. Financial data were obtained from the IMF official databases (IFS, Balance of payments Statistics Yearbook) and also from Rider (1994). Our normative definition of external balance is based on IMF (2002).

Table A1 Definition of Variables

Variable	Notation	Data Source
Effective foreign import demand (in millions of US dollars)	S	NiGEM, February 2004
Effective world real interest rate (in percent)	r	NiGEM, February 2004
Import prices (index)	P_m	NiGEM, February 2004
Export prices (index)	P_x	NiGEM, February 2004
US dollar exchange rate (in domestic currency terms)	E	NiGEM, February 2004
Real domestic output (in constant prices)	Y	NiGEM, February 2004
Real exports (base index)	X	NiGEM, February 2004
Real imports (base index)	M	NiGEM, February 2004
Domestic consumer price index (CPI)	P	NiGEM, February 2004
Export volume in the base year (1994) (in millions of US dollars)	$\overline{X}$	IMF, Balance of payments Statistics Yearbook, 2002
Import volume in the base year (1994) (in millions of US dollars)	$\overline{M}$	IMF, Balance of payments Statistics Yearbook, 2002
Initial level of external debt (in millions of US dollars)	D_0	NiGEM, February 2004; IFS; and Rider (1994) 1/
Stock of FDI (in percent of GDP)	FDI	NiGEM, February 2004; IFS; and Rider (1994) 1/
Net external debt target for time T (T = 2022) (in percent of GDP)	D^*	Calculations based on IMF (2002)

1/ Calculations based on NiGEM projections of FDI flows and initial estimates of an FDI stock are consistent with the estimate of an initial stock of NFA.

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